Characteristics and Evolution of Stars

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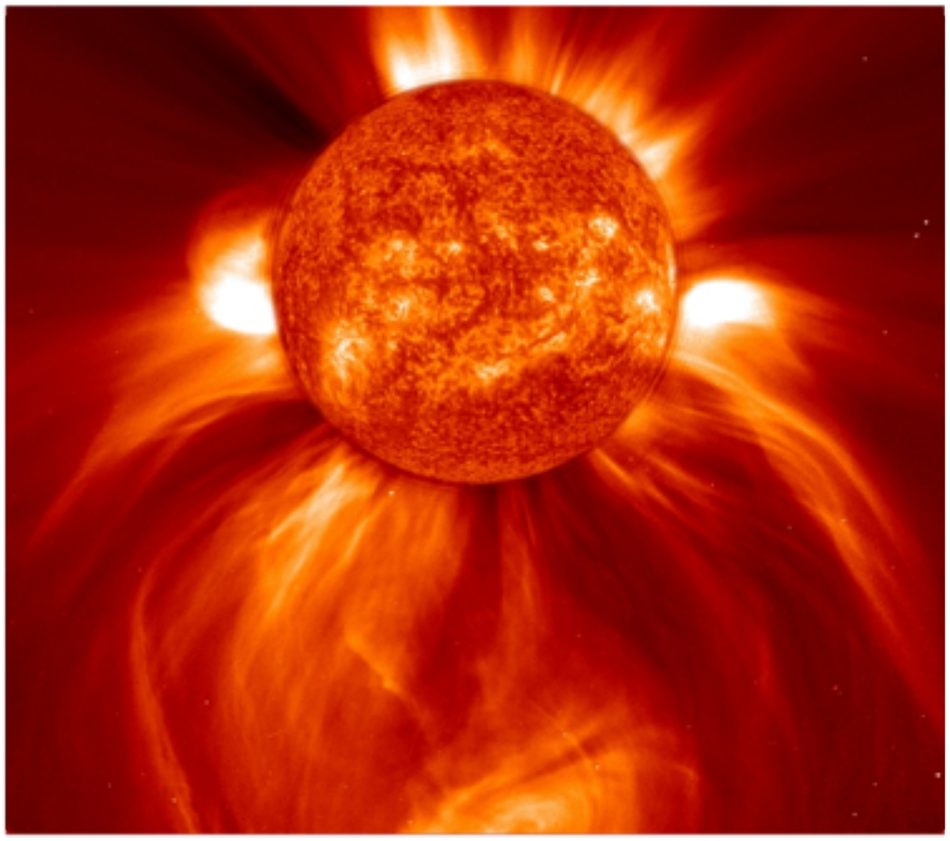
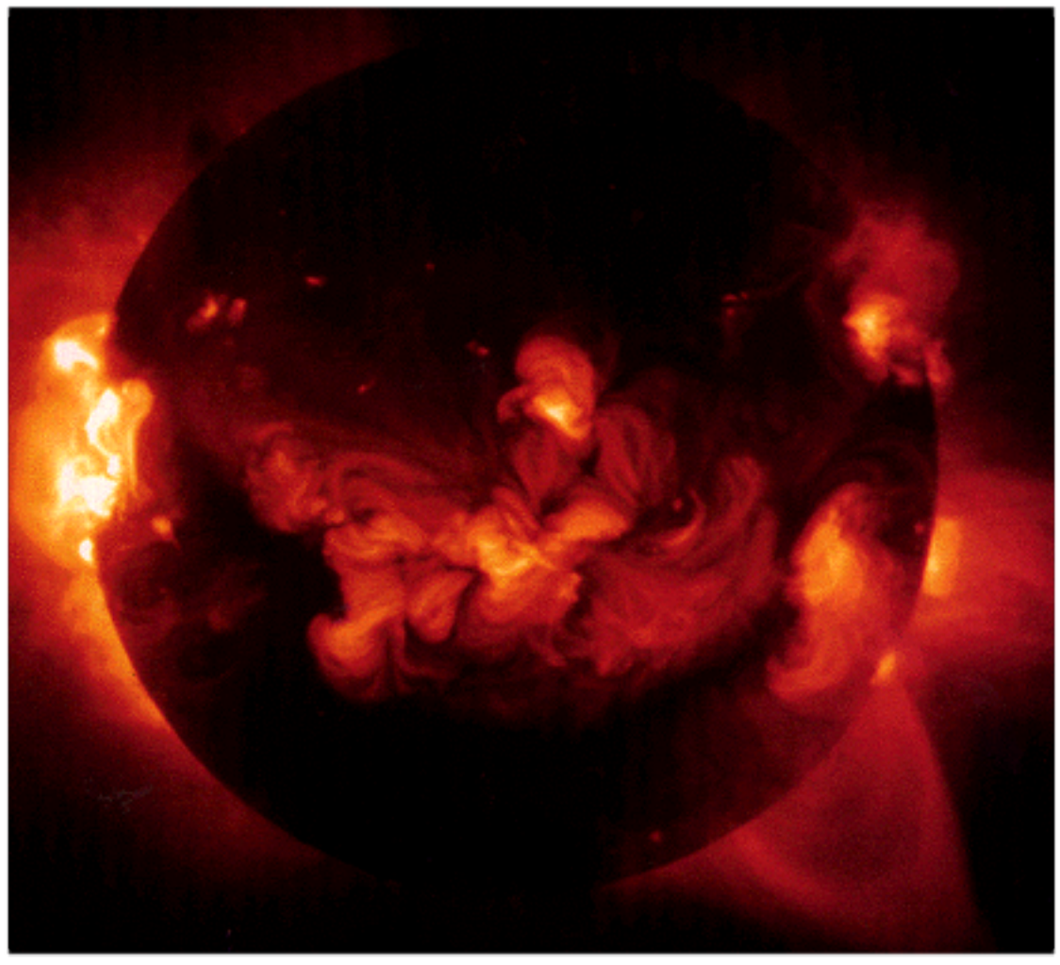
A STAR IS A BODY OF GASES THAT GIVE OFF A TREMENDOUS AMOUNT OF RADIANT ENERGY IN THE FORM OF LIGHT AND HEAT.





Facts about Stars

- The sun in 300,000 times more massive than our Earth
- Our sun is considered to be a medium sized star
- Large stars have a mass 50 times the mass of the sun

Composition and Temp

- To determine the temperature and composition of a star, scientists study the light given off by a star.
  - Spectrometer - a device that separates light into different wavelengths.
  - Spectrum - display of colors and lines when starlight is passed through a spectrometer.

Comp and Temp, Con't

- Every chemical element has it's own unique spectrum
  - Hydrogen is the most common, helium is the second most common
- The color of a star tells us it's temperature:
  - **Blue** = hottest
  - **Red** = coolest
  - **Yellow** = middle range

Distance

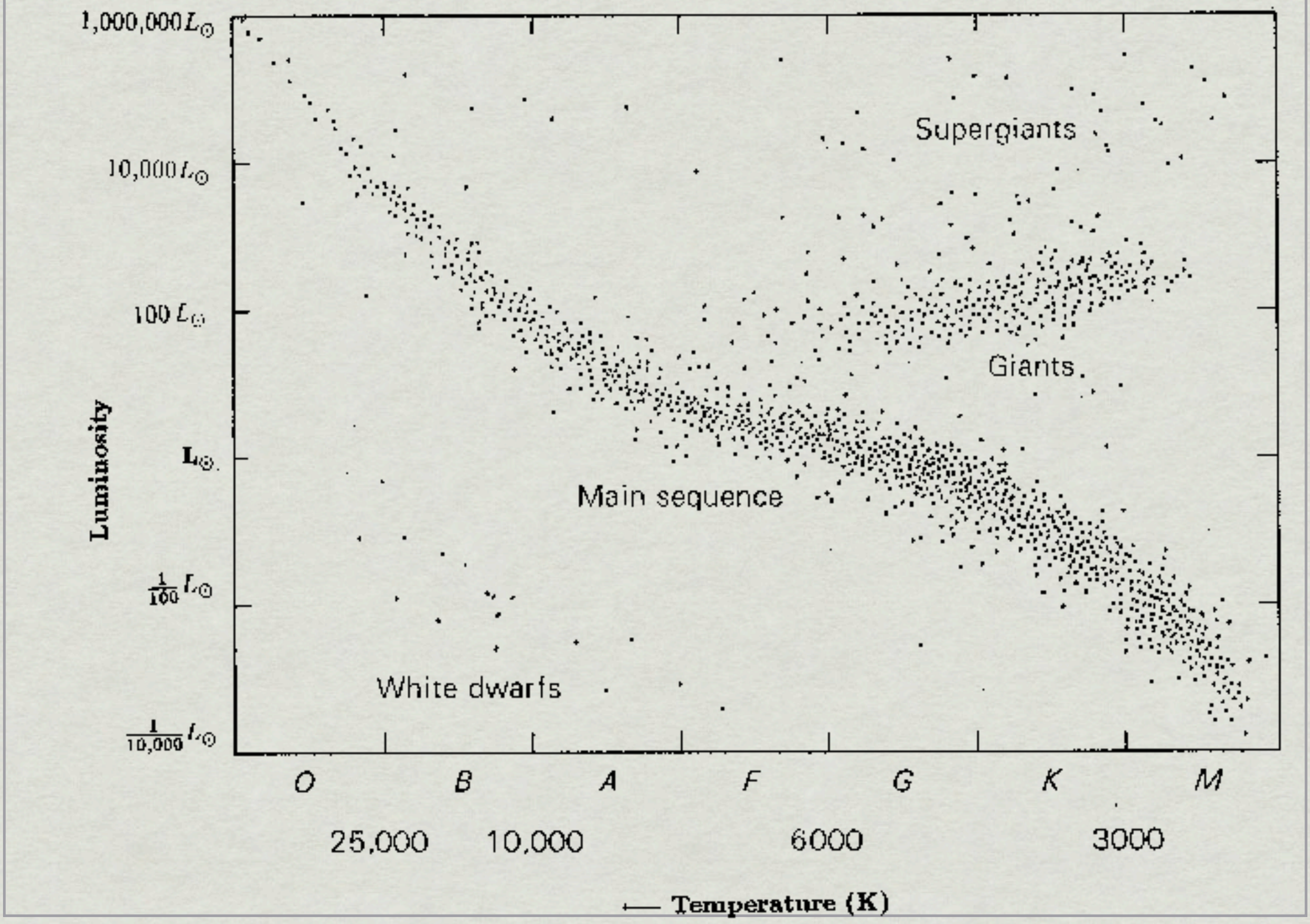
- The distances between the stars and Earth are so huge that they are measured in light-years.
  - Light-year = 1 light year equals the distance it travels in a year
    - 1 light-year = 9.5 trillion km or 186,000 mps in a year
    - It takes light 7.3 minutes to travel from the sun to the Earth
    - The nearest star to our solar system, Alpha Centari, is 4.3 light-years away!

Distance, Cont'd

- Parallax - determines the distances from Earth to a star
  - The more stars appear to shift, the closer it is to Earth
  - Astronomers can calculate stars distance up to 1,000 light-years away
  - Mostly done with photos
  - Parallax + spectrum = stars distance from the Earth!

Classification of Stars

- The brightness of most stars increases as their surface temperature increases (H-R sequence)
  - Main sequence stars - Most stars fall into this range (includes the sun and many visible stars)
  - Giants - Huge stars that have cool temperatures but are bright because they are large
  - Whits Dwarfs - small stars that are very hot but appear dim because they are small


Hertzsprung-Russell Diagram for Stars in the Solar Neighborhood
1,000,000 $L_\odot$
10,000 $L_\odot$
100 $L_\odot$
$L_\odot$
$\frac{1}{100}$ $L_\odot$
$\frac{1}{10,000}$ $L_\odot$
Luminosity
Supergiants
Giants
Main sequence
White dwarfs
O
B
A
F
G
K
M
25,000
10,000
6000
3000
← Temperature (K)

STELLAR EVOLUTION

- The typical star lasts for billions of years, making it hard to observe one star throughout its lifetime
- Scientists study stars in different stages of development.

STAGES OF DEVELOPMENT

- Nebula
- Protostar
- Main-Sequence Star
- Giants and Supergiants
- White Dwarf stars
- Supernovas
  - Neutron Star
  - Black Hole

NEBULA

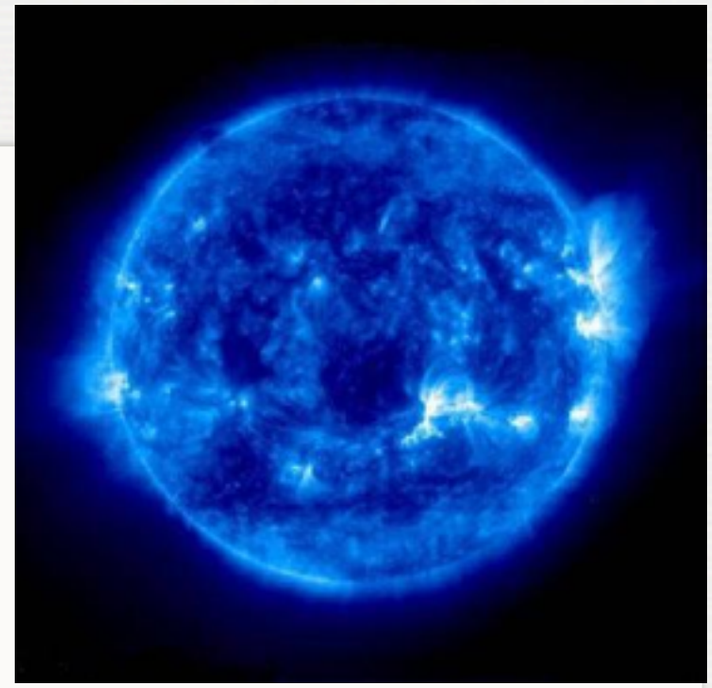
- A star begins as a cloud of gases and dust
- Composed of:
  - 70% hydrogen
  - 28% helium
  - 2% heavier elements

- Gases do not attract until forces cause them to attract

PROTOSTAR

- When those gases start to come together and become more dense.
- This causes them to begin spinning rapidly
- Heat the gases and they become plasma
- The continued heat and pressure causes nuclear fusion
- Once nuclear fusion occurs, it will burn for billions of years.
- Often the forces are so great that more than one star is formed from one nebula.

MAIN SEQUENCE STAR



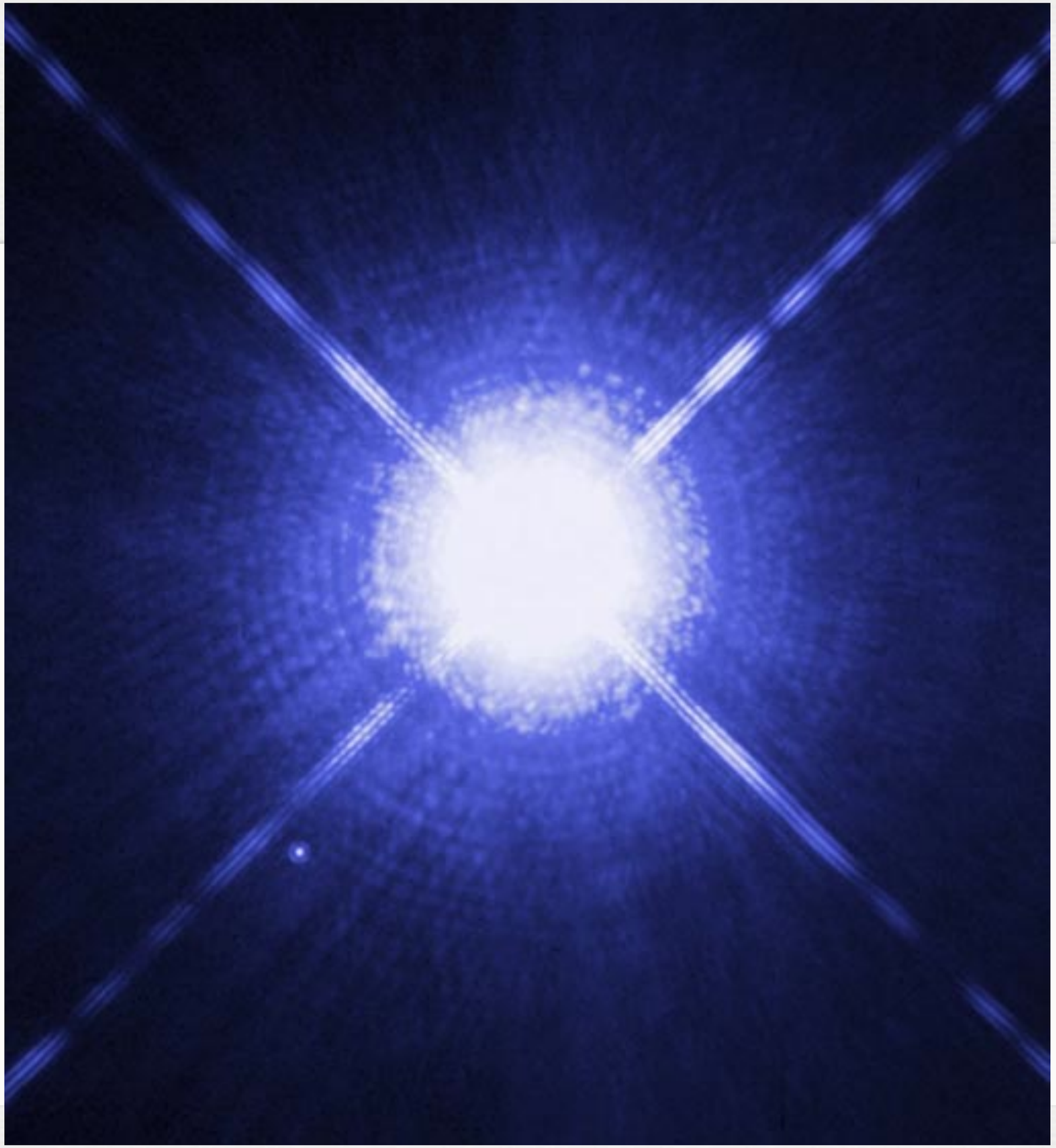
- This is the longest life stage
- Energy is generated at the core
- Hydrogen is converted into helium and energy is released
  - 1g of hydrogen converted into helium has enough energy to keep a 100-W light bulb on for 3000 years.

GIANTS AND SUPERGIANTS

- Without hydrogen a stars core begins to contract due to gravity
- Helium atoms begin to fuse with carbon atoms, causing the star to expand
- The expanding causes them to become giants or supergiants
  - Scientists estimate that in the last 5 billion years, the sun has only used up 5% of its original hydrogen

WHITE DWARF STARS

- The end of helium marks the end of the giant stage
- The core is still heated and illuminates the remaining gases
- Will have multiple explosions that cause novas
- A white dwarf can shine for billions of years before it cools



SUPERNOVAS

- Giant exploding stars
- Star under so much pressure that it explodes
- Happened in 1054
  - Energy was equal to the suns energy over a 500 million year period.